Neighbourhood design and fear of crime: A social-ecological examination of the correlates of residents' fear in new suburban housing developments

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ABSTRACT

This study explored the relationship between neighbourhood design and residents' fear of crime in new suburban housing developments. Self-report and objective data were collected as part of the RESIDential Environments (RESIDE) Project. A neighbourhood form index based on the planning and land-use characteristics that draw people into public space, facilitate pedestrian movement and ensure the presence of 'territorial guardians' was developed for each participant ($n=1059$) from objective environmental data. With each additional index attribute, the odds of being fearful reduced (trend test p value$=0.001$), and this persisted even after progressive adjustment for demographics, victimisation, collective efficacy and perceived problems. The findings support the notion that a more walkable neighbourhood is also a place, where residents feel safer, and provides further evidence endorsing a shift away from low density, curvilinear suburban developments towards more walkable communities with access to shops, parks and transit.

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1. Introduction

Fear of crime is more prevalent than actual victimization (Hale, 1996), yet relatively few studies have explored the environmental correlates of fear. Fear has a pervasive association with health, with studies indicating that fear can heighten feelings of anxiety and unease to the detriment of psychological wellbeing and mental health (Whitley and Prince, 2005; Stafford, 2007; Green et al., 2002; White et al., 1987; Ross, 1993). Furthermore, to alleviate their fears, people may constrain their social and physical activities to avoid certain places or situations they perceive to be unsafe (Skogan and Maxfield, 1981; Liska et al., 1988). This withdrawal can affect the formation of social ties (Ross and Jang, 2000), social participation (Stafford, 2007) and physical activity levels (Foster and Giles-Corti, 2008). Moreover safety concerns can induce parents to constrain their children's physical activities (Carver et al., 2010). There is also evidence of a direct association between fear of crime and physical health, whereby frequent stimulation of physiological stress mechanisms can cause these responses to malfunction, leading to a range of disease outcomes (McEwen, 1998). Thus, improved knowledge of the neighbourhood characteristics that minimise fear could benefit both mental and physical health.

Recent research has focused on the capacity for characteristics of the built environment to encourage physical activity (Owen et al., 2004; Saelens and Handy, 2008). Many of these physical attributes also have links to crime and perceived safety, suggesting some commonalities between those environments that encourage walking and those that influence neighbourhood safety. For example, physical disorder (e.g., litter, graffiti and vandalism) and 'suburban incivilities' (e.g., presentation and upkeep of properties) (Brown et al., 2004) can amplify feelings of insecurity (Lewis and Maxfield, 1980; Austin et al., 2002; Wood et al., 2008) and these negative visual cues can deter residents from engaging in physical activity (Ellaway et al., 2005; King, 2008; Mendes de Leon et al., 2009; Miles, 2008; Nagel et al., 2008; Shenassa et al., 2006; Sugiyama and Ward-Thompson, 2008).

Broader neighbourhood design and planning attributes (e.g., street connectivity, residential density and retail destinations) demonstrate positive associations with utilitarian walking (Frank et al., 2005; Owen et al., 2007; Lund, 2003; McCormack et al., 2008; Saelens et al., 2003); however, evidence suggests many walkability characteristics are associated with more crime (Cozens, 2008; Schneider and Kitchen, 2007), and that homogenous neighbourhoods with restricted vehicular and pedestrian access are safer (Poyner, 1983; Greenberg et al., 1982). The association between neighbourhood planning and perceptions of safety is more ambiguous, and may be confused by the distinction between actual crime and fear of crime. These are separate, but related constructs: crime is a tangible event (Schneider and Kitchen, 2007), whereas fear of crime is an 'emotional reaction of dread or anxiety to crime or symbols that a person associates with

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crime' (Ferraro, 1995, p. 8). Thus, the neighbourhood attributes that reduce crime may not be the same as those that minimise residents' fears about crime. Many environmental characteristics have assumed associations with perceived safety through their capacity to generate natural surveillance (Jacobs, 1961); however, there is little empirical evidence supporting this. Indeed, evidence that neighbourhood design can promote or inhibit residents' feelings of safety is somewhat elusive.

1.1. Neighbourhood design and crime

Many crimes are opportunistic, committed as people go about their daily activities (including travel between activities), when they discover potential targets (Brantingham and Brantingham, 1993). Routine activity theory suggests three elements are necessary for a crime to occur: (1) an offender; (2) a target; and (3) the absence of a capable guardian (Clarke and Felson, 1993; Cohen and Felson, 1979). This theory supports the notion that walkable neighbourhoods, which ensure the presence of guardians, will restrict crime. However, the effectiveness of guardians to prevent crime remains contingent on the type of crime. Capable guardians may prevent serious offences, yet large volumes of people can serve to mask low-level offences (e.g., pick pocketing, drug sales) (Loukaitou-Sideris, 1999).

In general, property crime occurs near destinations that attract both local residents and visitors (e.g., shopping centres, recreational facilities, transport nodes) (Beavon et al., 1994; Brantingham and Brantingham, 1993; Brown, 1982; Bowes, 2007), whereas crimes against the person occur in the home or close to drinking venues (Peterson et al., 2000; Gorman et al., 2001). Numerous studies have reiterated this association between non-residential land-uses and crime (Schweitzer et al., 1999; Greenberg et al., 1982; Smith et al., 2000; Gruenewald et al., 2006; Roncek and Lobosco, 1983; Wilcox et al., 2004). However, studies also suggest that some non-residential land-uses can be protective against crime. Peterson et al. (2000) found that certain destinations (e.g., recreation centres), which provide sites for positive resident interaction, were associated with less violent crime in disadvantaged neighbourhoods, while other land-uses (e.g., small businesses, churches) can augment the number of 'legitimate users' (Kurtz et al., 1998). This highlights the complexity of land-use and suggests that analyses that distinguish between business and resident oriented land-uses may be pertinent to the incidence of crime (Wilcox et al., 2004).

Permeable street layouts that facilitate walking appear to increase crime by improving access (Cozens, 2008). For example, gridded street networks have been associated with household burglary, as logical layouts make navigation and exploration easier (Brantingham and Brantingham, 1993). Doyle et al. (2006) generated a county-level indicator of walkability from block sizes and street connectivity, and identified a moderate positive correlation with crime (Doyle et al., 2006). Such links between connectivity and crime appear to be the consensus of much of the literature (Cozens, 2008; Schneider and Kitchen, 2007); however, there is some evidence to the contrary associating cul-de-sacs with property crime (Shu, 2000). Nonetheless, connectivity alone may not impact crime unless other elements are present that make the neighbourhood appealing to potential offenders (e.g., destinations, suitable targets) (Brantingham and Brantingham, 1993).

1.2. Neighbourhood design and fear

Fewer studies have examined direct effects between land-uses and perceived safety, and the findings are mixed. Living in close proximity to a grocery or convenience store was found to correlate with higher fear of crime (Schweitzer et al., 1999); however, other research found distance to the nearest commercial or industrial land-use had no bearing on fear (McCrea et al., 2005). Wood et al. (2008) found that as the number of destinations within 800 m of participants increased, feelings of safety diminished; however, this association attenuated after adjusting for neighbourhood design (i.e., gridded vs. curvilinear layout). The authors proposed that a threshold may exist, where an optimal number of destinations could promote feeling safe; and both the quality and type of destinations needs consideration (Wood et al., 2008).

Furthermore, Wood et al., 2008 hypothesised that suburbs designed to be more conducive to walking, thus encouraging interaction between neighbours, would be positively associated with social capital and feeling safe. New Urban planning also draws on the premise that building designs that promote natural surveillance and public spaces that facilitate social interaction will create safe, inviting streets for pedestrians (Congress for the New Urbanism, 2001). However, contrary to expectations, Wood et al. (2008) found residents in a conventional suburb (i.e., curvilinear street layout) felt safer than those in a hybrid (i.e., mix of grid and cul-de-sacs) or traditionally planned (i.e., grid layout) suburb.

The presence of green space has also generated some conflicting evidence. Vegetation can conceal perpetrators as they select a target, commit an offence and flee the scene (Nasar and Fisher, 1993) and promote fear by limiting visibility in the immediate vicinity (Nasar and Jones, 1997). However, green space with well-maintained grass and widely spaced high canopy trees does not impede visibility nor provide cover for criminal acts. Indeed, some studies suggest vegetation may promote safety. In residential settings, the presence of vegetation has been associated with less fear of crime (Nasar, 1982), a greater sense of safety among residents (Kuo et al., 1998a; Maas et al., 2009) and lower reported crime (Kuo and Sullivan, 2001).

1.3. Pathways connecting land-use, crime and fear

Researchers have proposed various mechanisms to explain the associations between non-residential land-uses and crime. The central premise is that these land-uses interfere with informal social control via two pathways: (1) for each non-residential land-use there is an absence of guardians exercising territorial behaviours (e.g., surveillance, maintenance) and (2) non-residential land-uses draw outsiders to the area, making it more difficult for residents to distinguish strangers from locals (Taylor et al., 1995). Consequently, a breakdown of resident-based social control could be anticipated, where there are territorial gaps (e.g., vacant lots, schools). This notion is supported by the association between non-residential land-uses, incivilities and crime (Wilcox et al., 2004; Taylor et al., 1995; Kurtz et al., 1998). For instance, Kurtz et al. (1998) identified that residents in streets with more non-residential land-uses reported lower levels of perceived resident-based control (e.g., knowing their neighbours, monitoring suspicious activity).

Other studies suggest local residents withdraw in response to the visitors that businesses attract. Baum et al. (1978, p.266) found blocks with a market or pharmacy had more pedestrian traffic; however, residents on these streets were less likely to interact in the street environment and more likely to report 'excessive unwanted contact'. The authors suggest this withdrawal into the private realm is a means of regulating exposure to strangers (Baum et al., 1978). Similarly, Appleyard and Lintell (1978) proposed that residents in streets with greater volumes of

traffic restricted their exposure to pedestrian and vehicle traffic by limiting their use of building frontages and minimising contact with neighbours (Appleyard and Lintell, 1978). Such responses hamper territorial behaviour, curb social interaction and ultimately weaken residents' social control. Indeed, a comparison of residents in streets with different traffic speed limits found those residing in 'encounter zones' (i.e., 20 km per hour speed limits) were more likely to linger in their street and know their neighbours than those living in streets with higher traffic speeds. Moreover female residents in 'encounter zones' were less fearful of criminal victimisation (Sauter, 2008).

However, there is an alternative perspective on the role of strangers. The research described above interprets 'strangers as a source of danger', but others conceptualise 'strangers as a source of safety' (Hillier, 2004, p. 31). Jacobs (1961) proposed that diverse land-uses attracted more people, generating pedestrian traffic, making streets interesting, lively and safe. This in turn encourages surveillance from adjacent buildings (Jacobs, 1961). While the original concept was based on a city environment, the premise of 'eyes on the street' has since been applied to suburbs, despite Jacobs' own caution against this (Jacobs, 1961; Cozens, 2008). Similarly, the connection between vegetation and fear has also been explained by focusing on the positive attributes of the land-use. Kuo and Sullivan (2001) propose that: (1) vegetation augments informal surveillance through active use of these spaces and (2) green space deters violent crime, because it alleviates mental fatigue which is a 'psychological precursor to violence' (Kuo and Sullivan, 2001). In the former pathway, natural surveillance is generated from both adjacent buildings and park visitors; and the space itself provides a site for social interaction (Skjaeveland and Garling, 1997; Sullivan et al., 2004), which helps to promote feelings of safety (Kuo et al., 1998b).

Nonetheless, the contention that people will feel safer when more people are present remains ambiguous. An Australian qualitative study had mixed results, with no clear consensus as to the number of people associated with feeling safe (Lupton, 1999). Alternatively, other research characterised unsafe places as 'quiet and deserted' and 'poorly lit', supporting the assertion that the presence of more people helps alleviate fear (Vrij and Winkel, 1991). However, any association between people and perceived safety may still be contingent on the social environment. Hunter and Baumer (1982) found subjective exposure to pedestrian traffic only made people feel safer, if they were strongly connected to the neighbourhood. Respondents without this connection experienced greater fear of crime in the presence of the same amount of pedestrian traffic. The authors concluded that 'each additional person represents another potential offender' (Hunter and Baumer, 1982, p. 127).

Neighbourhood designs that enhance residents' perceptions of safety may be a vehicle to improve mental and physical health. This study used a social–ecological model to investigate the correlates of fear of crime in suburban neighbourhoods. Numerous individual, social and physical environmental variables influence crime, fear of crime and walking, and many of these correlates are interconnected. We hypothesised that the suburban planning and land-use characteristics that encourage the presence and circulation of people would be associated with less fear of crime among residents.

2. Methods

2.1. Study context

The RESIDential Environments (RESIDE) Project is a five-year longitudinal study evaluating the impact of urban design on health in Perth, Western Australia. All people building new homes in the study areas were invited to participate (response rate 33.4%). Participants completed a self-report questionnaire before they moved into their new home, and on two subsequent occasions after they relocated (at 12 and 36 months). They received four telephone and two mail reminders before being considered lost to the study. Geographic Information Systems (GIS) was used to generate individual-level objective measures for each participant's neighbourhood. The questionnaire defined the neighbourhood as a 10–15 min walk from home, and most objective measures assessed the 1600 m road network distance from each participants house. RESIDE was approved by The University of Western Australia's Human Research Ethics Committee. The RESIDE project is described fully elsewhere (Giles-Corti et al., 2008).

This paper describes a cross-sectional study that was part of the larger (longitudinal) RESIDE project, based on a subset of RESIDE participants ($n = 1059$), who had lived in their new homes for between 12 and 36 months. Participants were spread across 74 new housing developments, clustered within 48 suburbs. The study sample was older and more affluent than the wider Perth metropolitan area population (Australian Bureau of Statistics, 2007).

2.2. Outcome variable

Fear of crime was derived from the question: in your everyday life, how fearful, or not, are you about the following situations? Items were: (1) being approached on the street by a beggar or homeless person; (2) being cheated or conned out of your money; (3) having someone break into your house while you're *not* at home; (4) having someone break into your house while you're at home; (5) being attacked by someone with a weapon; (6) having your car stolen; (7) being robbed or mugged on the street; (8) having your property damaged by vandals; (9) having someone loiter near your home at night; and (10) having a group of juveniles disturb the peace near your home (Cronbach's $\alpha = 0.93$) (Ferraro, 1995; Warr and Stafford, 1983). Participants rated each item on a Likert scale (1=not at all fearful, 5=extremely fearful), and those with an average score of three or higher (i.e., at least somewhat fearful) were categorised as fearful ($n = 275$).

2.3. Individual characteristics

Demographic information included age, sex, education and household income. Area socio-economic status was derived from the Australian Bureau of Statistics (ABS) Socio-economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage (IRSD) from the 2006 census. Study participants were split into quintiles based on the disadvantage score for their respective postcodes (Pink, 2008). Victimisation items were adapted from Austin et al. (2002). Participants were asked whether they (or someone they personally knew) had been the victim of crime in their current neighbourhood in the last two years (crimes included: household burglary, harassment or threatening behaviour, or a physical attack or mugging). Data were tested for associations between length of residence and fear of crime, but there were no differences and this variable was excluded.

2.4. Neighbourhood perceptions

The neighbourhood problems items were similar to those used elsewhere (Ferraro, 1995; Hill, 2005; Latkin and Curry, 2003; Perkins et al., 1992; Ross et al., 2002), but had a greater focus on neighbourhood presentation and upkeep. Participants were asked to rate different problems on a four-point scale (1=not a problem,

4=significant problem), and factor analysis was used to collapse items into themes. *Neighbourhood maintenance* included: (1) unkempt lawns and gardens; (2) houses and fences not looked after; (3) unkempt nature strips, parks and open spaces; (4) upkeep of children's playgrounds; (5) littering and dumping of rubbish in public areas; and (6) poor street lighting (Cronbach's $\alpha=0.89$). *Social incivilities* included: (1) using or selling drugs; (2) harassment, intimidation or threatening behaviour; (3) discarded needles/syringes; (4) gang-related criminal activity; (5) abandoned vehicles; (6) uncontrolled pets; and (7) noisy neighbours (Cronbach's $\alpha=0.91$). *Graffiti and vandalism* included: (1) graffiti on public property; (2) graffiti on private property; and (3) vandalism (Cronbach's $\alpha=0.92$). *Property crime* included: (1) car theft; (2) theft from cars; and (3) household burglary (Cronbach's $\alpha=0.89$), and *violent crime* included: (1) assault; and (2) domestic violence (Cronbach's $\alpha=0.90$). Items falling outside the factor structure were examined individually (i.e., vacant houses/blocks, loitering teenagers, and dangerous/drink driving). All scales/items were dichotomised, with respondents that averaged greater than two (i.e., one or more items in the scale was 'a moderate problem') classified as perceiving a problem.

2.5. Social environment

Collective efficacy (i.e., the belief that other residents will act for the common good) combined two scales: (1) informal social control; and (2) social cohesion and trust (Sampson et al., 1997). The established scale was altered slightly to reflect local language and mores. *Informal social control* included the conviction that their neighbours would intervene if: (1) they noticed children spraying graffiti on a local building; (2) children were showing disrespect to an adult; (3) they noticed children wagging school and hanging out in the local park; (4) a fight broke out in front of their house; and (5) the nearest police station was threatened with closure (1=very unlikely; 5=very likely) (Cronbach's $\alpha=0.78$). *Social cohesion and trust* included: (1) people in this neighbourhood do not share the same values (reversed); (2) most people in this neighbourhood can be trusted; (3) people in this neighbourhood generally do not get on with each other (reversed); (4) this is a close knit neighbourhood; and (5) I believe my neighbours would help in an emergency (1=strongly disagree, 5=strongly agree) (Cronbach's $\alpha=0.70$). Individual-level collective efficacy was recoded into low, medium and high.

The Western Australia Police supplied the spatial locations of reported crimes for the calendar year corresponding with questionnaire completion. We examined: (1) actual and attempted burglary and (2) crimes committed against the person in public space (e.g., threats, disorderly behaviour, assault; robbery). It was theorised that personal crime in public space might influence residents' perceptions of safety more than those committed in the private realm. However, violent crime tends to cluster in lower socio-economic and unstable residential neighbourhoods, whereas burglary affects the full spectrum of society (Sampson et al., 1997) and can generate fear in sectors of society, where other crimes are rare (Skogan and Maxfield, 1981). The impact of burglary on victims is generally less debilitating than personal crime; yet burglary occurs more frequently and therefore its 'aggregate effect' reaches a greater proportion of society (Skogan and Maxfield, 1981). Crime density measures were calculated for various distances of each participant's address; however, only crime within 1600 m was included in the results.

2.6. Physical environment

The physical environmental variables focused on the home environment, destinations in the proximate neighbourhood

(400 m), and the planning and land-use characteristics of the wider neighbourhood (1600 m). Participants reported the presence of house attributes that might affect their privacy (e.g., building setback) or increase their vulnerability to crime (i.e., secondary space adjacent to house). An additional privacy item was adapted from Austin et al. (2002): I am satisfied with the privacy my house provides from neighbours (1=strongly disagree, 5=strongly agree). Participants who agreed or strongly agreed were classified as being satisfied.

Other environmental variables were generated from objective sources using GIS. Geo-coded destinations were sourced from a commercial entity and the network distances between participants' homes and a variety of destinations were calculated. We hypothesised that nearby destinations would have a stronger association with fear of crime than distant destinations, thus the count of retail destinations, transit stops and schools were generated for a 400 m network distance from each participant's address.

A *neighbourhood form index* was created to encapsulate the broader composition of each participant's 1600 m neighbourhood. The index combined characteristics that would encourage people into the public realm (i.e., retail land and public open space), facilitate their movement (i.e., street connectivity), and ensure the presence of territorial guardians (i.e., residential density, residential land and less vacant land). Each component was generated for the individual's 1600 m 'service area'. Although not a walkability index *per se*, the scale incorporates several components typical of these indices. Street connectivity (the ratio of the count of three way intersections to the total service area) and residential density (the ratio of the area in residential use to the number of residential dwellings within the service area) were based on a methodology developed by Frank et al. (2005). Further variables were generated to reflect the proportion of different land-uses. RESIDE developed a methodology to allocate Planning Land Use Categories (PLUC) codes to cadastral parcels based on property rating assessments and reserve reports from Landgate (the Western Australian State Government's land information agency). These apportioned land-uses were used to calculate land area summaries for the proportion of: (1) vacant or unclassified land (and its reverse representing the proportion of developed land); (2) residential land; (3) retail land; and (4) public open space. All six elements were dichotomised on the median into higher and lower groupings, and added to create the index. Thus, participants with the highest neighbourhood form score lived in areas with (relatively) higher street connectivity and residential density, less vacant land, and more residential land; retail land, and public open space. However, it should be noted that the median values used to dichotomise many variables were indicative of the study neighbourhoods (i.e., recently established suburban Greenfield developments). For instance, neighbourhoods had extremely low proportions of retail land (median=0.4%), and large tracts of vacant or unclassified land (median=45.9%).

2.7. Statistical analyses

All analyses were conducted in SPSS version 15, using logistic regression with generalised estimating equations (GEE) to account for clustering within residential development. The distribution of most continuous variables was highly skewed, thus variables were dichotomised prior to analyses. Single factor models, controlling for established correlates of fear (i.e., gender, age, education, household income and area deprivation) identified the variables associated with fear of crime (p value < 0.1). These were included in subsequent models, where groups of variables (individual characteristics, perceptions, social environment and

physical environment) were examined in a series of backwards elimination procedures. Significant variables (p value < 0.05) were then included in the multivariate models. To examine the independent association between the physical environment and fear, successive models adjusted for increasingly proximate factors.

3. Results

The results confirmed some well-established associations between demographic characteristics and fear of crime: women and older adults were significantly more fearful; and participants with a university education or higher household income had lower odds of being fearful (Table 1). All subsequent analyses adjusted for these demographic variables; and although not presented in the tables, the observed associations persisted.

Table 2 presents the estimated univariate associations between the other study variables and fear of crime. As anticipated, participants who had experienced victimisation had significantly greater odds of being fearful (OR=1.65, 95% CI=1.26–2.15). Numerous neighbourhood perceptions were examined, and although most respondents perceived few problems, all scales/items were significantly associated with fearfulness. However, after the backwards stepwise elimination (results not shown), three neighbourhood problems remained significantly associated with residents' fear: (1) neighbourhood maintenance (OR=1.82, p=0.008); (2) social incivilities (OR=4.45, p=0.001); and (3) property crime (OR=1.88, p=0.005).

With regard to the social environmental variables, collective efficacy was strongly associated with fear of crime; however, objective crime was inconsequential for this sample. Although not shown, other analyses examined crime occurring within more proximate distances, and again, no associations emerged. The categorisation of the crime variables (and crime frequencies) highlights the relative safety of the study neighbourhoods, as minimal serious crime was reported.

The majority of the house characteristics and proximate destinations held no association with fear of crime. However, living in a house with a shorter setback from the street (< 5 m) was associated with greater odds of being fearful (OR=1.43, 95% CI=1.06–1.93), and having a transit stop present was associated with lower odds of being fearful (OR=0.71, 95% CI=0.54–0.94). Furthermore, the neighbourhood form index was significantly associated with fear of crime (trend test p value=0.001).

Variables within each group that remained significant after the backwards elimination process were included in the final multivariate analyses (Table 3). The neighbourhood form index, transit stops and house setback were each significantly associated with fear of crime (Model 1). In Model 2, the social environmental variable (collective efficacy) was included. While it did not alter the strength of the physical environmental correlates, suggesting no mediating effect, collective efficacy retained its significant independent association with fear (p value=0.001). In Model 3, victimisation was added to the analyses, and in accordance with the literature, was significantly associated with fear of crime (Hale, 1996). Notably, adjustment for victimisation did little to alter the strength of the association between fear and other variables in the model.

Respondents' neighbourhood perceptions were included in Model 4. Perceiving each of these as a problem in the neighbourhood was associated with significantly greater odds of being fearful, particularly in the case of social incivilities, where the odds were five times greater. The perception of problems appeared to slightly attenuate the protective role of collective efficacy, suggesting that perceiving local problems is connected with weaker social cohesion. However, adding perceived problems to the model also strengthened the association between the neighbourhood form index and fear of crime (trend test p value=0.000), indicating that once the influence of perceptions on fear is accounted for, the independent association between neighbourhood planning and fear is stronger.

Across all models, the neighbourhood form index maintained a significant independent association with reduced fear of crime. This association held despite progressive adjustment for social environmental variables (Model 2), personal variables (Model 3) and individual perceptions (Model 4). With each successive characteristic included in the index, the odds of being fearful reduced, to the point where participants in neighbourhoods that rated highly for all six elements had approximately 60% lower odds of exhibiting fear of crime. The capacity of the neighbourhood form index to persevere throughout these analyses gives some support to the notion that physical neighbourhood design may help promote feelings of safety.

4. Discussion

The results suggest a direct association between neighbourhood planning and fearfulness. The neighbourhood form index maintained a significant inverse association with fear of crime and this trend persevered despite progressive adjustment for numerous other variables. Notably, the results imply it is not simply one or two characteristics that contribute to feeling safe, but the cumulative effect of several planning and land-use elements. It provides some support for the New Urban assertion that walkable neighbourhoods, which facilitate social contact between neighbours, could also promote feelings of safety (Congress for the New Urbanism, 2001), and indicates a shift away from very low density curvilinear development may serve a dual purpose by alleviating residents' fear of crime and promoting walking.

Table 1
Odds ratios from multivariate model for demographic characteristics associated with fear of crime.

Independent variable	%	Adjusted OR	95% CI	p Value
Gender				
Male	38	1.00		**0.000**
Female	42	1.66	1.29–2.13	
Age				
20–39	43	1.00		**0.005**
40–59	44	1.51	1.10–2.08	**0.011**
60+	13	2.13	1.31–3.45	**0.002**
Highest education level				
Primary or secondary	37	1.00		0.124
Trade or apprentice	38	0.85	0.59–1.24	0.404
University	24	0.63	0.40–0.99	**0.044**
Household income				
Less than $49 999	18	1.00		**0.039**
$50–69 999	19	0.83	0.52–1.35	0.458
$70–89 999	20	0.96	0.60–1.51	0.848
$90 000	42	0.61	0.43–0.88	**0.008**
No response	1	0.67	0.13–3.53	0.635
Area disadvantage (SEIFA index)				
1 (More disadvantage)	20	1.00		0.134
2	15	0.80	0.97–3.15	0.820
3	28	0.72	0.90–2.86	0.369
4	16	1.23	0.60–1.85	0.146
5 (Less disadvantage)	20	1.07	0.64–2.14	0.395

Adjusted for clustering within residential development.

Table 2
Single factor odds ratios for: (1) personal characteristics; (2) neighbourhood perceptions; (3) social environmental; and (4) physical environmental characteristics associated with fear of crime.

Independent variable	%	Single factor models[a]	
		OR	**p Value**
1. Personal characteristics			
Victimisation	30	1.65 (1.26–2.15)	**0.000**
2. Neighbourhood perceptions (a moderate problem vs. not a problem/a minor problem)			
Neighbourhood maintenance	16	3.02 (2.01–4.53)	**0.000**
Social incivilities	5	9.54 (4.87–18.69)	**0.000**
Graffiti and vandalism	21	2.37 (1.75–3.20)	**0.000**
Property crime	13	3.21 (2.23–4.62)	**0.000**
Violent crime	5	6.14 (3.31–11.40)	**0.000**
Vacant houses or blocks	12	2.65 (1.71–4.11)	**0.000**
Loitering teenagers	12	3.56 (2.40–5.29)	**0.000**
Dangerous or drink driving	11	2.81 (1.85–4.25)	**0.000**
3. Social environment			
Collective efficacy			
Low	15	1.00	**0.003**
Medium	68	0.60 (0.40–0.90)	**0.014**
High	16	0.43 (0.26–0.70)	**0.001**
Actual or attempted home burglary			
Lowest 80% (<141 crimes)	80	1.00	0.984
Highest 20% (141+ crimes)	20	1.01 (0.64–1.57)	
Crimes committed in public space			
Lowest 80% (<23 crimes)	80	1.00	0.466
Highest 20% (23+ crimes)	20	0.87 (0.59–1.27)	
4. Physical environment			
House characteristics (present vs. absent)			
Public open space adjacent to house	22	1.16 (0.85–1.59)	0.350
Public access way adjacent to house	12	0.99 (0.64–1.54)	0.972
Back laneway	8	0.72 (0.43–1.18)	0.188
Vacant block adjacent to house	22	1.02 (0.70–1.42)	0.925
House located on a corner block	20	1.43 (0.96–2.12)	0.077
Satisfied with house privacy	94	0.68 (0.45–1.03)	0.070
House setback distance			
Less than 5 m (vs. more than 5 m)	25	1.40 (1.04–1.89)	**0.028**
Proximate destinations (within 400 m) (present vs. absent)			
Any retail destination	19	0.69 (0.43–1.11)	0.123
Transit stops	45	0.69 (0.52–0.92)	**0.012**
School	11	0.80 (0.51–1.23)	0.306
Planning and land-use characteristics			
Neighbourhood form index			
0–1	22	1.00	**0.025**[b]
2	19	0.68 (0.39–1.17)	0.164
3	19	0.58 (0.36–0.93)	**0.023**
4	17	0.63 (0.39–1.03)	0.063
5	16	0.48 (0.26–0.85)	**0.013**
6	7	0.45 (0.24–0.84)	**0.012**

[a] Single factor models adjust for gender, age, education level, household income, area disadvantage and clustering within residential development.
[b] The trend test equivalent: p value=0.001

Previous research has found components of the neighbourhood form index to be either protective against crime (Kuo and Sullivan, 2001; Hillier, 2004; Poyner, 1983) or facilitators of crime (Brantingham and Brantingham, 1993; Cozens, 2008; Doyle et al., 2006; Greenberg et al., 1982; Nasar and Fisher, 1993); however, studies associating these components with perceptions of safety are less conclusive (Schweitzer et al., 1999; McCrea et al., 2005; Wood et al., 2008), and the cumulative effect of several attributes is rarely examined. The index used in this study blends characteristics that: (1) ensure the presence of territorial guardians; (2) encourage people into the public realm; and (3) facilitate pedestrian movement throughout the neighbourhood. One underlying theme common to all index components is their potential to generate pedestrian traffic. In neighbourhoods with less vacant land, higher proportions of residential land, and higher residential densities, there are more potential pedestrians. If these neighbourhoods also have parks and retail facilities to draw residents into the public realm, and well connected streets to facilitate walking; then, more residents may walk in their neighbourhoods. It follows that neighbourhood form may help alleviate fear of crime, because residents feel safer when more people circulate through the neighbourhood and supports the assertion that 'eyes on the street' enhance perceptions of safety. Thus, despite the caveats issued about applying 'eyes on the street' to a suburban context (Jacobs, 1961; Cozens, 2008), these findings lend support to the contention that suburban planning

Table 3
Odds ratios from the multivariate models examining the physical, social and personal factors associated with fear of crime.

Independent variable	Model 1 physical		Model 2 social		Model 3 personal		Model 4 perceptions	
	OR	p	OR	p	OR	p	OR	p
Neighbourhood form index								
0–1	1.00	0.057[a]	1.00	0.072[b]	1.00	**0.044**[c]	1.00	**0.005**[d]
2	0.70	0.213	0.71	0.250	0.70	0.244	0.64	0.143
3	0.60	**0.042**	0.60	**0.050**	0.59	**0.041**	0.57	**0.038**
4	0.65	0.081	0.66	0.103	0.64	0.087	0.56	**0.020**
5	0.51	**0.022**	0.50	**0.019**	0.50	**0.024**	0.44	**0.006**
6	0.47	**0.017**	0.48	**0.025**	0.45	**0.011**	0.36	**0.001**
Transit stops								
No	1.00	**0.016**	1.00	**0.013**	1.00	**0.014**	1.00	**0.014**
Yes	0.71		0.69		0.64		0.70	
House setback								
More than 5 m	1.00	**0.020**	1.00	**0.017**	1.00	**0.021**	1.00	**0.033**
Less than 5 m	1.43		1.44		1.44		1.43	
Collective efficacy								
Lowest tertile			1.00	**0.001**	1.00	**0.003**	1.00	0.052
Middle tertile			0.57	**0.006**	0.60	**0.010**	0.74	0.164
Highest tertile			0.41	**0.000**	0.42	**0.001**	0.52	**0.016**
Victimisation								
No					1.00	**0.000**	1.00	**0.014**
Yes					1.64		1.44	
Neighbourhood maintenance								
Not/bit of a problem							1.00	**0.038**
A moderate problem							1.66	
Social incivilities								
Not/bit of a problem							1.00	**0.000**
A moderate problem							5.08	
Property crime								
Not/bit of a problem							1.00	**0.010**
A moderate problem							1.78	

Adjusted for gender, age, education, income, area disadvantage and clustering within residential development.
Neighbourhood form index trend tests:

[a] The trend test equivalent of this was: 0.003.
[b] The trend test equivalent of this was: 0.004.
[c] The trend test equivalent of this was: 0.000.
[d] The trend test equivalent of this was: 0.000.

can positively influence feelings of safety. Furthermore, the inverse association between transit stops and fear of crime adds credence to this explanation.

Nonetheless, the findings need to be considered in the context of the study neighbourhoods. When the index components were analysed separately (analyses not shown), the strongest individual element was the proportion of retail land, which was associated with significantly lower odds of being fearful. Yet neighbourhoods with a 'higher' proportion of retail land needed only 0.4% of their area to be classified as retail to rate inclusion in the 'higher' grouping. Indeed, 290 participants had no retail land whatsoever in their service area. This reflects a sample of study neighbourhoods, early in their development, characterised by few proximate facilities and services. However, additional analyses dichotomised the proportion of retail land at 2% or greater, and identified a similar association. While these findings suggest that Jacob's notion of 'eyes on the street' is indeed relevant to suburban environments (Jacobs, 1961), it is plausible that these neighbourhoods simply do not have enough retail businesses present to negatively affect perceived safety. Wood et al.'s (2008) suggestion that an optimal number of destinations could have a positive influence on perceived safety may be pertinent. In this study, neighbourhoods may simply not achieve the threshold necessary for destinations to become detrimental to perceived safety; however, the presence of at least some retail appears beneficial.

Our interpretation of the neighbourhood form index is that suburbs which promote pedestrian traffic help minimise fear;

however, having a shorter house setback was associated with increased odds of being fearful. This parallels other research, where residents in detached housing felt safer than those in duplexes, townhouses or apartments (Wood et al., 2008). It is plausible that residents may desire a degree of vibrancy in their neighbourhoods; but with the option to withdraw into the private realm. By maintaining a larger buffer between their own home and public space, residents are better able to insulate themselves from any negative neighbourhood influences. Other studies confirm the importance of an adequate balance between public and private space to various outcomes, including neighbouring behaviours (Skjaeveland and Garling, 1997), depression (Weich et al., 2002) and psychological distress (Brown et al., 2009). Moreover residents in houses with shorter setbacks may be less able to regulate visual and social contact, affecting feelings of personal control (Brown et al., 2009), and the inability to control social interaction has been linked with helplessness and psychological distress (Evans, 2003).

An alternative mechanism explaining the connection between built form and fearfulness is that neighbourhood design that provides opportunities for social interaction (Baum and Palmer, 2002), may promote feelings of safety (Merry, 1981). However, in these analyses, both the physical and social environments held significant independent associations with fear, and there was no evidence to suggest that collective efficacy mediated the association between neighbourhood form and fearfulness. Rather, residents' perceptions of local problems contributed to an attenuating association between collective efficacy and fear,

suggesting that neighbourhood problems and collective efficacy are connected. In neighbourhoods, where social control is weak, more crime and disorder are evident (Sampson et al., 1997; Markowitz et al., 2001). Ross and Jang (2000) documented an interaction between social ties (a necessary precursor to developing collective efficacy) and perceived disorder, where the presence of social ties diminished, but did not eliminate the influence of perceived disorder on fear (Ross and Jang, 2000). Similarly, the results presented here show perceived problems lessened the strength of the association between collective efficacy and being fearful, although causality cannot be determined.

The findings confirmed that perceived problems were significant correlates of fear. After adjustment, three neighbourhood problem scales remained significant: (1) neighbourhood maintenance; (2) social incivilities and (3) property crime. Residents in neighbourhoods with more perceived disorder have higher levels of fear (Ross and Jang, 2000), and higher status neighbourhoods are associated with less disorder and crime (McCord et al., 2007). Taylor et al. (1985) suggest that residents' responses to neighbourhood disorder differ according to income. In high SES neighbourhoods indicators of disorder are uncharacteristic and easily ignored, whereas in low SES neighbourhoods residents may have other priorities, and may blame external structural forces (e.g., landlords and government agencies) for neglecting area maintenance. However, in middle income neighbourhoods with mixed tenure, where many homeowners experience financial stress associated with mortgage payments, residents may be less resilient to neighbourhood deterioration (Skogan, 1986, p. 213). The higher level of homeownership means outsiders cannot be blamed for disorder, and residents may question their neighbourhood's future (Taylor et al., 1985). In this study, social incivilities, which comprised problems ranging from serious (e.g., selling drugs) to minor (e.g., noisy neighbours) were salient to residents fear of crime, but physical disorder became non-significant after adjustment. This may be due to the more proximal (i.e., social environmental), temporaneous nature of social incivilities, whereas physical incivilities are somewhat distal (i.e., physical environmental) and may be interpreted as the actions of bored local teenagers.

In this study, few participants' perceived problems and crime statistics indicated neighbourhoods with relatively low crime levels. The association between neighbourhood maintenance and property crime, and higher fear may reflect the participants' priorities. As new home buyers, participants are heavily invested in their neighbourhoods (both emotionally and financially); and problems with neighbourhood presentation and property crime threaten this investment. Indeed, the second most important reason why participants chose their new housing development was safety from crime (Giles-Corti et al., 2008). The findings are consistent with other research associating well-kept neighbourhoods with greater feelings of safety (Austin et al., 2002; Nasar, 1982; Wood et al., 2008), and support the notion that suburban incivilities (e.g., unkempt lawns) 'constitute more pervasive and salient incivilities' in suburban environments (Brown et al., 2004, p. 305). Furthermore, as mentioned, property crime has the potential to generate fear in sectors of society, where serious offences are scarce, and this appears to be the case for these participants.

4.1. Limitations

This study has several limitations. First, the generalisability of the results is limited due to the study sample. Participants were new homeowners, living in freshly built suburbs, which generally had low levels of relative socio-economic disadvantage. As such, it could be anticipated that these residents would experience minimal fear of crime, and the neighbourhoods themselves would be reasonably free from crime and disorder. However, despite being a relatively affluent sample, the established associations between gender, age, education and household income, and fear of crime were evident. Indeed, research suggests that residents in neighbourhoods undergoing rapid change are more likely to be fearful (Krannich et al., 1989, 1985). While this finding was based on rapidly urbanising rural environments, they do parallel the sudden transformation that occurs when new housing developments are constructed on the urban fringe. Second, the neighbourhoods themselves had limited variability. Neighbourhoods were largely homogenous, dominated by single family detached housing with few destinations, and large tracts undeveloped land. Thus, the associations between the physical environment and fear of crime may have been underestimated through failure to detect a significant association over the limited range of the physical environment (Sallis et al., 2009). Third, the study design was cross-sectional, so causality cannot be inferred. While the study hypothesis was that neighbourhoods designed to facilitate pedestrian circulation and ensure the presence of territorial guardians would deter fear, it is equally possible that people who are fearful relocate to neighbourhoods that dissuade people from entering and moving about in public. Future research might examine whether our findings represent a middle class phenomenon, and whether similar associations emerge for diverse populations in neighbourhoods with mixed tenure and housing styles.

The study also had several strengths. First, we used a social–ecological framework, and the finding that individual, social and physical environmental characteristics were significant correlates of fear in the final model validated this approach. Second, wide-ranging, comprehensive data sources were used to generate subjective and objective measures. In particular, GIS was used to quantify the attributes of participants' individual neighbourhoods. The development and application of the neighbourhood form index highlighted that separate characteristics may not emerge as independently significant, and in some instances, the cumulative effect of several attributes holds a stronger association. Third, the fear of crime items adopted in this study were based on an established criminology scale (Ferraro, 1995), which met a series of recommendations, including that items: (1) explicitly refer to 'fear' rather than worry or concern about crime; (2) specifically mention crime; and (3) are not hypothetical (Ferraro and LaGrange, 1987; Hale, 1996). While the items were selected to circumvent some failings of other fear measures, they nonetheless remain open to criticism. Quantitative measures can overestimate fear, men may underreport their fear, and many instruments struggle to capture temporal, social and spatial dimensions of fear (Farrall et al., 1997).

The findings confirmed the importance of some traditional approaches to crime prevention, and their relevance to minimising fear of crime (i.e., targeting criminal victimisation, social disorder and property crime). However, the results also draw attention to other facets of the environment that have the potential to promote feelings of safety. Greater investment in maintenance programs (for public and private space), and retro-fitting neighbourhoods to encourage walking may be mechanisms to increase perceived safety. Natural experiments that assess the impact of neighbourhood modifications (e.g., revitalisation programs, improved transit) on residents' perceived safety could elucidate any causal relationship between the physical environment and fear.

5. Conclusion

Fear of crime has been associated with social withdrawal, and poorer mental and physical health (Stafford, 2007; White et al.,

1987; Ross, 1993; Chandola, 2001), yet few empirical studies have examined the association between neighbourhood planning and fear of crime. We presented evidence linking the design of suburban neighbourhoods with residents' feelings of safety. Planning characteristics that act in combination to ensure the presence of territorial guardians, encourage people into the public realm, and facilitate pedestrian movement were associated with significantly lower odds of being fearful. While not without limitations, the findings lend support to the notion that a more walkable neighbourhood is also a place where residents feel safer. Planning policies that engender a shift away from low density suburbia towards more walkable environments could benefit psychological wellbeing and physical health.

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